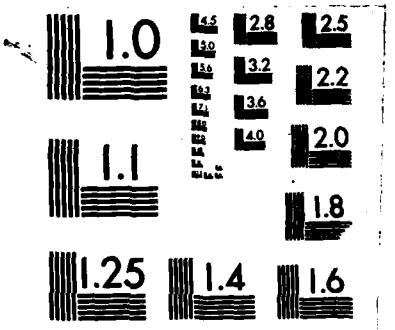
AD-A155 754 COMBINED QUARTERLY TECHNICAL REPORT NUMBER 36 PLURIBUS 1/1
SATELLITE IMP (INT.. (U) BOLT BERANEK AND NEWMAN INC
CAMBRIDGE MA S BLUMENTHAL FEB 85 BBN-5977
UNCLASSIFIED MDA903-80-C-0353 F/G 17/2 NL

END
FILMED
DTIC



Bolt Beranek and Newman Inc.

Report No. 5977

Combined Quarterly Technical Report No. 36

Pluribus Satellite IMP Development
Mobile Access Terminal Network

February 1985

Prepared for:
Defense Advanced Research Projects Agency

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 5977	2. GOVT ACCESSION NO. A155 757	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) COMBINED QUARTERLY TECHNICAL REPORT NO. 36		5. TYPE OF REPORT & PERIOD COVERED Quarterly Technical 11/1/84 - 1/31/85
		6. PERFORMING ORG. REPORT NUMBER 5977
7. AUTHOR(s) Steven Blumenthal		8. CONTRACT OR GRANT NUMBER(s) MDA903-80-C-0353 N00039-81-C-0408
9. PERFORMING ORGANIZATION NAME AND ADDRESS Bolt Beranek and Newman Inc. 10 Moulton Street Cambridge, MA 06238		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Advanced Research Projects Agency 1400 Wilson Boulevard Arlington, VA 22209		12. REPORT DATE February 1985 13. NUMBER OF PAGES 5
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) DSSW Navalex Room ID Washington, DC 20360 The Pentagon Washington, DC 20310		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVED FOR PUBLIC RELEASE/DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Computer networks, packets, packet broadcast, satellite communication, gateways, Pluribus Satellite IMP, shipboard communications, ARPANET, Internet.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This Quarterly Technical Report describes work on the development of Pluribus Satellite IMPs: and on shipboard satellite communications.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Report No. 5977

COMBINED QUARTERLY TECHNICAL REPORT NO. 36

PLURIBUS SATELLITE IMP DEVELOPMENT
MOBILE ACCESS TERMINAL NETWORK

February 1985

This research was supported by the Defense Advanced Research Projects Agency under the following contracts:

MDA903-80-C-0353, ARPA Order No. 3214
N00039-81-C-0408

Submitted to:

Director
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209

Attention: Program Management

Table of Contents

1. Introduction

This Quarterly Technical Report is the current edition in a series of reports which describe the work being performed at BBN in fulfillment of several ARPA work statements. This QTR covers work on several ARPA-sponsored projects including (1) development of the Pluribus Satellite IMP; and (2) development of the Mobile Access Terminal Network. This work is described in this single Quarterly Technical Report with the permission of the Defense Advanced Research Projects Agency. The work on the Mobile Access Terminal Network ~~under contract 0408~~ has been completed. Some of this work is a *continuation of efforts* previously reported on under contracts DAHC15-69-C-0179, F08606-73-C-0027, F08606-75-C-0032, MDA903-76-C-0214, MDA903-76-C-0252, N00039-79-C-0386, and N00039-78-C-0405.

2. PLURIBUS SATELLITE IMP DEVELOPMENT

During this quarter, BBN's efforts were concentrated on Wideband Network operations, systems integration, and BSAT development.

2.1. Wideband Network Systems Integration and Operations

Wideband Network Operations were suspended for a six-week period from October 1, 1984 to November 14, 1984 to allow for the investigation and correction of a few network problems. During the first part of November, BBN completed the implementation of a software fix for the PSAT "5 stream bug." The stream scheduling table in the PSAT had been sized to support only streams for the original four Wideband Network sites. Enlarging the table turned out to be a formidable task requiring the rearrangement of a large amount of the PSAT software. With the fix in place, it is now possible for each of the 10 sites to have their own channel stream. During the second half of the month, the network operated with as many as 8 and 9 sites on the channel at the same time.

The network returned to operational status during the latter part of November, but operations continued to be hampered by frequent outages due to satellite channel interference. A team representing BBN, Lincoln Laboratory, Linkabit, and Kaiser, Inc. met at BBN during the last week of November to investigate the satellite channel interference. The Wideband Network carrier signals were found to be amplitude modulated by a large square-wave signal. This square-wave modulation was determined to be caused by another TDMA network operated by the Department of Energy (DOE) which shares our satellite channel transponder. Each satellite channel transponder has only a limited amount of signal power available; the DOE network was operating at a considerably higher power level than the Wideband Network and was actually robbing power from the Wideband Network.

The investigation team presented their findings to DARPA and Western Union on November 30, 1984. They recommended that either the Wideband Network or the DOE network be moved to a different transponder. Western Union was asked by DARPA to suggest a plan to solve this problem.

During December, BBN and Linkabit continued to conduct tests on the satellite channel to further characterize its performance and to determine if there was a compromise position which would allow both the Wideband Network and the DOE network to share the same transponder. Although the bit-error-rate (BER) was found to be within acceptable range, the extremely sharp edged square-wave modulation caused severe bursty phase errors which affected the ability of the Linkabit modem to sync-up to received bursts; this resulted in the loss of a large number of entire bursts. No compromise was found that did not involve a fairly substantial decrease in the DOE power levels. Western Union is continuing to investigate the availability of an alternate transponder for the Wideband Network. To alleviate the problem, the Wideband Network will operate in BPSK mode at a maximum data rate of 1.5 Mb/s until a transponder change can be made.

On December 21, another PSAT software version was released which contained some refinements concerning this robustness issue. Among the changes were: 1) A new leader assignment scheme. In the old system, the lowest numbered site that is currently eligible would be selected as new leader in the case of leader loss. Unfortunately, the lowest numbered sites in the net are the sites with 5-meter dishes and thus with a higher noise characteristic. The new scheme selects the highest numbered sites; largely 7-meter sites. This should reduce the liklihood of spurious leader transitions; 2) A fast restart feature which allows reinitialization of the PSAT without ESI initialization. This allows a site that has crashed to return to the net in about 15 seconds (in most cases) instead of one or two minutes; 3) Further repairs to host monitoring code; and 4) Addition of diagnostic traps and additional code to aid in further characterization of stability problems. Another feature, which was planned, for inclusion in this release but was discarded, was an increase in the leader transmission time-out constant; currently 32 frames. It

was discovered that this constant is tightly coupled to the design of many scheduling and synchronization functions; its alteration would require the revision of large amounts of complex code.

2.2. BSAT Software Development

Complex packet switching systems with many internal modules, such as the BSAT, can be difficult to describe to those without a technical background in the field. In November, a Demonstration Mode was added to the top level command process of the BSAT. This displays a set of labelled, interconnected boxes that correspond to the principal modules in the BSAT. The display also shows the number of messages per second, bursts per second, total messages or bursts, or other relevant measures of throughput for each module. The display is updated every few seconds.

Demonstration Mode also contains commands to run the Message Generator with a canned set of control parameters. The generated messages go through the datagram path of channel uplink, through channel downlink, to the Echo Host, back through Local Delivery to the Message Sink. The displayed numbers illustrate not only the throughput in host messages per second but also the effects of message aggregation in channel bursts.

Also in November, a bug was discovered and fixed in the synchronous I/O library routines. This bug appeared only when the system was heavily loaded and caused buffers to be lost and data to be corrupted. A similar bug was fixed in December. This bug in the Chrysalis routine Free_Buffer_Chain caused buffers to be lost when the queue of free buffers was nearly empty.

The BSAT's processor node selection algorithm was enhanced so that multiple BSATs, or BSATs and other programs such as the Voice Funnel or ESI Simulator, could be run on the same machine. This code

was also installed in the ESI Simulator. This improves our ability to test the BSAT by making "multi-site" tests possible using a single Butterfly machine.

Initial coding of the datagram reservation synchronization software was completed in December and debugging started. The ability to perform multi-site tests was immediately put to use testing this code. Also in December, much of the code for CPODA was added to the Scheduler process.

In January, the members of the BSAT software development group prepared for an internal BBN management and peer review of the BSAT design. The preparation for this review involved documenting much of the system design and implementation; outdated documentation was brought up to date. The conclusion of the reviewers was that the BSAT had a sound design. However, a shift toward emphasizing reliability resulted in greater consideration of ways to minimise the effect of some types of failures. As a result of the review, more effort will be placed on making the system reliable; less effort will be placed on new ways to increase performance at this time.

As part of the documentation effort, the BSAT/ESI-B Interface Specification was revised. The new document includes a complete description of the Physical, Link, and Network level interfaces for the BSAT and the ESI-B.

Also during January, the ESI Simulator was modified to use the latest version of Chrysalis. version 2.1, from much older version 1.6. Several Unix utilities were written to make it easier for several programmers to work on the BSAT without conflicts in editing, compiling, etc. The BSAT group participated in the Butterfly Satellite Modem Interface (BSMI' design review. BSMI's will be used in the Wideband Network when they are available.

DISTRIBUTION

ARPA
Director (3 copies)
Defense Advanced Research Projects Agency
1400 Wilson Blvd.
Arlington, VA 22209
Attn: Program Management
R. Kahn
R. Ohlander
B. Leiner

DEFENSE DOCUMENTATION CENTER (12 copies)
Cameron Station
Alexandria, VA 22314

DEFENSE COMMUNICATIONS ENGINEERING CENTER
1860 Wiehle Road
Reston, VA 22090
Attn: Maj. J. Fredricks

DEPARTMENT OF DEFENSE (2 copies)
9800 Savage Road
Ft. Meade, MD 20755
Attn: R. McFarland C132

DEFENSE COMMUNICATIONS AGENCY
8th and South Courthouse Road
Arlington, VA 22204
Attn: Code B645
Glynn Parker, Code B626

NAVAL ELECTRONIC SYSTEMS COMMAND
Department of the Navy
Washington, DC 20360
Attn: B. Hughes, Code 6111
F. Deckelman, Code 621T

MIT Laboratory for Computer Science
545 Technology Square
Cambridge, MA 02138
Attn: D. Clark

MIT Lincoln Laboratory
244 Woods Street
Lexington, MA 02173
Attn: C. Weinstein

DISTRIBUTION cont'd

USC Information Sciences Institute
4676 Admiralty Way
Marina Del Rey, CA 90291
Attn: D. Cohen
S. Casner

DISTRIBUTION cont'd

BOLT BERANEK AND NEWMAN INC.
1300 North 17th Street
Arlington, VA 22209
Attn: E. Wolf

BOLT BERANEK AND NEWMAN INC.
10 Moulton Street
Cambridge, MA 02238

S. Blumenthal
M. Brescia
R. Bressler
T. Calderwood
P. Cudhea
A. Echenique
R. Edmiston
W. Edmond
G. Falk
W. Glynn
J. Goodhue
S. Groff
R. Gurwitz
J. Haverty
F. Heart
J. Herman
R. Hinden
D. Hunt
S. Kent
A. McKenzie
D. Melone
W. Milliken
R. Quiros
R. Rettberg
H. Rising
J. Robinson
E. Rosen
P. Santos
S. Storch
R. Thomas
C. Topolcic
R. Waters
B. Woznick
Library

END

FILMED

8-85

DTIC